NUC 46C Fuel

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Div. of Ind. Hyg.
New York City

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Division of Industrial Hygiene
Att: Dr. Robert Katz
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Sylvania Corning Nuclear Corp.
Cantiague Road
Hicksville, New York

Date visited:	February 27, 1959 April 21, 1959
Visited by:	Mr. Irving Kingsley, Ind. Hyg. Engineer Mr. W. Harris, Chief, Industrial Hygiene and Radiation Section, U.S.A.E.C., N.Y. Operations office.
Persons interviewed:	Mr. Henry Grieb, Radiation Safety Supv. Mr. R. Andree, " " office
Purpose of visit:	Survey plant for compliance with rules of Code Bulletin No. 38
Origin:	Request from Medical Section

In accordance with a request from the Medical Section, the above plant was visited to determine whether it was in compliance with the rules of Code Bulletin No. 38. The long time period between the time of request and visit was due to difficulties in obtaining security clearance and coordinating the activities of the various personnel involved to arrange a mutually satisfactory time of visit as well as to illness, vacation schedules and shutdown of the plant for several months. The actual plant survey was made during the first visit. The second visit was made for the purpose of examining the company's air sampling and film badge records.

REPORT

There are two separate reactor fuel element manufacturing facilities at this location. The commercial plant makes many different kinds of fuel elements for different reactors. Natural, enriched, and depleted uranium are handled. About 250 people are employed on these operations on a three-shift, 7-day basis.

A separate building is used to prepare fuel for an Atomic Energy Commission plant using raw natural uranium. These operations have been reduced to some extent recently and there are about 130 people employed here on a 1-shift, 5-day per week basis.

Description of Operations

Commercial Plant

The sequence of operations is as follows: The uranium-aluminum

materials to be alloyed are weighed out in the accountability area and toted to the furnace room where they are melted at 960°C in a vacuum furnace exhausted by lateral hoods at top and bottom. The molds are poured in place beneath the furnace and the ingots removed from the molds in a ventilated hood located adjacent to the furnace. The ingots are heated, rolled in a mill exhausted by a canopy hood and sheared. Plugs are then punched out of the sheared pieces. These cores are placed in spaces which have been provided in aluminum plates called picture frames. There are two cores per plate. The plates are then hot-rolled to reduce their width by 50% and increase their length by 200%. They are sheared in half, faced on both sides with aluminum plate, tack welded on the sides and hot-rolled to a predetermined thickness. Then fluoroscopy is performed to determine the core length and its position. After another cold rolling operation, the plates are fluoroscoped again so that they can be centerpunched for the last shearing process. Finally, the plates are assembled into the elements and are inspected.

All these operations are performed in several rooms in either buildings #2 or #9. About 4 to 5 melts are prepared every 24 hours. The maximum weight percent of uranium in the alloy is about 40%. The average is about 8% to 12%. Due to criticality considerations, no more than two kilograms of U-235 (enriched) would be melted at one time and two ingots could be made from this. The maximum weight of any alloyed batch would be about 80 lbs.

Powdered compacts are also made in the same building containing the vacuum furnace (building #2). Mixtures of uranium oxide and stainless steel powders are weighed, blended and pressed. Weighing and pressing are done in ventilated dry boxes. The compacts are put in a bag for transport, sintered in an exhausted furnace, stamped and fitted into plates. Stainless steel plates are placed on either side and welded around the edges. The sandwich is heated in a hydrogen atmosphere furnace, rolled, sheared and then handled in a manner similar to that previously described. These operations are also performed in buildings #2 and #9. The production welding in building #9 involves the heliarc process and is unventilated.

A.E.C. Plant

This is building #1 and involves the pressure bonding of uranium in aluminum cans. Due to security reasons, a detailed description of the operations will not be given. Included, however, are nitric acid and caustic cleaning, nickel plating, molybdenum sulfide spraying, heat and pressure bonding, aluminum trimming and wire brushing and cleaning of die parts.

Building #21

Production machining is done here. Lathes, grinders, cut-off wheels, etc. are provided for operations on normal bare uranium. The machinery is run wet.

Burning Building #3

This is a separate building used to burn scrap, uranium pellets and contaminated waste. Burning is done in trays set in enclosed transite hoods provided with slots in the front for raking the material. The burned residue is subsequently dumped from the trays into drums resting on the floor of the enclosure. Burning is now done about once a week.

Ventilation and Measurements

Commercial Plant

Building #2

The powdered compact dry boxes, vacuum furnace and ingot hood are exhausted in one system. A filter box located on the roof and containing AAF Deep Bed Filters is used as the dust collector. Velocities of 200 fpm were found in the openings of the hood containing the press and 300 to 400 fpm through the air lock opening in the weigh hood. Compacts were not being made at this time. The vacuum furnace was also not in operation as changes in its construction and ventilation were in progress. About 400 fpm was measured at the edge of the canopy hood over the rolling mill.

Building #9

The sintering furnace exhaust system also includes an AAF Deep Bed Filter unit as a dust collector.

Other exhaust systems are provided for several additional operations not previously mentioned which are performed during the forming and finishing of the elements. These are as follows:

1. Spraying a sodium silicate bonding material. This is done in a booth on a table. The average velocity through the opening was about 75 fpm. The space from the floor to the table top was open, short circuiting air. Baffles were not provided.

2. Degreasing - This is done in an electrically heated perchlorethylene vapor degreaser measuring 38" x 48" and having a freeboard of 17". Cooling coils are provided, as is one thermostat at the level of the coils. A hoist is provided but hand operation is practised. Standard

ventilation by lateral slots on the two long sides is provided. The ventilation rate was about 20 cfm per sq. ft.

3. Cleaning in hot water, alkali, acid. There are 8 small tanks on a stand in an enclosing hood having an average face velocity of 50 fpm.

4. Removal of heat from an electrically heated aluminum brazing furnace in the assembly room. The canopy hood provided at this oven was ventilated to maintain an inward velocity at its edge of 100 to 150 fpm.

5. An electrostatic precipitator collection system is provided for a centerless grinder, lathe, cut-off machine and rod straightener in the north east corner of the room.

In addition there are 2 hoods in the laboratory where accountability control analyses, scrap reprocessing, ingot sample testing, etc. are performed. Face velocities of 25 to 50 fpm were found.

A.E.C. Plant

1. Two booths are provided for the spraying of a water-base solution of molybdenum disulfide. Average velocity through the booths was 75 to 100 fpm.

2. Aluminum trimming and wire brush cleaning of the dies are exhausted in one system. Velocities of 150 to 400 fpm were measured in the hood openings. These operations do not give rise to uranium dust. A general air inlet from an office and an exhaust line from a vacuum pump are also included in this system. A dust collector is not provided. Rectangular piping is used, and the branch pipe from the die cleaning machine enters directly into the main pipe at its end.

3. Cleaning tanks are exhausted by rear slots with tapered connections and 50 to 100 fpm was measured at the tank edge.

Building #21

Two exhaust systems including filter boxes with AAF Deep Bed Filters are provided for the production machines. Some machines have enclosing hoods and some are exhausted by open end pipes. None of these machines were in operation and tests were not made.

Burning Building

About 300 to 400 fpm was measured in the hood slots.

Two deep mat filter units are provided for collecting the dust released during this operation. These filter boxes and the others are equipped with manometers to measure the pressure drop across the units. The fans are on the clean sides of the filters. The units are inspected and

filters changed monthly, being sprayed with varnish for dust suppression before removal. The used filters are drummed and shipped for disposal.

Air Tests

Air tests were taken at those operations in progress at the time of the visit. All results indicated concentrations comparable to the normal background. The locations were as follows:

1. Rolling mill in building #2 - breathing zone - hot rolling clad, sheared plates containing 18% U.235.
2. Rolling mill in building #2 - breathing zone - hot rolling clad, sheared plates containing 18% U.235.
3. In accountability vault - bldg. #9 - general air.
4. Rolling mill in building #9 - breathing zone - hot rolling clad, powdered cores
5. Rolling mill in building #9 - breathing zone - hot rolling clad, powdered cores
6. Shearing two plates building #9 - breathing zone - plates contain 2 gms. of uranium
7. Storage room building #1 - general air

The company has extensive records of air samples taken throughout the plants, dating back many years. All new operations are surveyed and a complete air sample survey is made at least every six months. Of the samples taken this year, results exceeding the maximum permissible level of about 100 disintegrations per minute per cubic meter of air, were found while weighing and compacting uranium oxide powder and at a turning machine used to cut rods to size. In the first case, the company claims to have eliminated the problem by redesigning the hoods, and in the second instance indicated that the amount of time actually spent at the operation was too small to classify it as hazardous. The velocities obtained at the powder weighing and compacting hoods should be adequate to control the hazard.

Individual time weighted average calculations are not made because the company feels it is unnecessary.

Outdoor monitoring is done. Thus far the results have indicated concentrations low enough not to be considered a problem.

External Radiation

Radiation measurements were made with a Juno meter in buildings #1, #2 and #9. The highest reading recorded was 50 mr/hr above a box of normal uranium blanks in the storage room of the A.E.C. building. This is mostly beta radiation and the intensity falls off so that a measurement about 3 feet above the box indicated a rate of 4 mr/hr.

Employees who may be in contact with uranium wear film badges which are checked weekly. This year's records indicate that in only one week for one person did the combined beta, gamma readings exceed 300 mrem. In this case the total was 325 mrem (285 mr beta). This man works in the plating area of the A.E.C. plant where close contact with the material is necessary.

Weekly radiation surveys are conducted by the plant's health and safety officer, including the taking of swipe samples. Decontamination methods are recommended as needed.

Accountability & Criticality

Commercial Plant - Buildings #2 and #9

Due to the expense of the materials and the fact that an accidental chain reaction may occur with uranium under certain conditions of enrichment, concentration, density, quantity, geometry, etc. extreme care is exercised in the handling, storage and processing of the materials and elements. One man per shift is in charge of the accountability vault in building #9. This involves checking the weight of incoming materials, the batch products, ingots and melt products. Extreme caution is exercised to insure that critical masses of material are not brought into the same processing area. Processed material in various stages of completion is also stored in racks separated so as to prevent interaction of fissionable materials. Raw material is kept in bird cages which insure that fissionable material can never be closer than about 2 feet from the next storage package.

Only non-critical quantities of finished material are allowed in the inspection room. About 10 stations having yellow lines painted on the floor outlining their boundaries are provided. Material cannot be moved beyond these confines.

A.E.C. Plant

There is no criticality problem here because the quantity of natural uranium needed to start and sustain a chain reaction greatly exceeds the amounts of uranium in the plant.

Medical

A physician is in the plant twice a day. Pre-employment examinations are given and routine physical examinations are conducted every 12 to 18 months. Urine samples are taken at new job locations, when a fire occurs, or when an air sample indicates high results.

Personal Hygiene

The company supplies the workers with pants, gloves, shirts, lab coats and plastic aprons at least twice a week. Shoe coverings are required for entry into some areas. Laundry is handled twice a week by a commercial laundry out of state. Lockers and showers are provided although there are no one way exits. Respirators are not required for any operations presently performed. There are gas masks, dust respirators, and air supplied respirators on hand for emergencies.

Pyrophoricity

Chips, trimmings, etc. from machining operations are allowed to accumulate in the building to the extent of filling 3/4 of a 5 gallon can. Thereafter they are stored in covered 30 gallon cans outside the building before being burned in the burning building. No quantity of scrap can be stored in the building overnight. The material is stored as it is formed in the operation, coated with coolant. The company reports no uranium fires in the past two years. Ansul dry powder and G-1 powder are used in the machining area as a fire extinguisher. CO_2, soda-acid, foam and water are also available.

Porter service is provided. Mostly wet swabbing is done and very seldom is vacuuming performed. Sweeping is not used. Adequate labeling of equipment, areas, etc. with radiation signs was noted.

Discussion

A.E.C. Plant

The dust hazard associated with this plant appears to be minimal because the raw uranium is plated almost immediately at the start of the operation and before that is handled as a massive cold piece.

Although the exhaust system for the aluminum trimming and die wire brushing operations is improperly designed, there does not appear to be any hazard associated with these operations so that the existing installation will probably be satisfactory.

Commercial Plant

This plant is essentially a job and development shop, processing many different types of articles. All manufacturing operations are not in progress every day. The criticality problem also limits the extent of the operations. It would thus be extremely difficult and time-consuming to make a complete survey at these premises. Furthermore, the nature and location of the operations appear to be in a constant state of flux, also hindering a proper health evaluation. Therefore, since they appear to have been obtained properly, it is felt that the company's air sampling records can be used as an indication of conditions. Although these records show, in general, favorable results, many readings are not strictly applicable in determining the present situation since they are old and were taken at different locations and under different conditions than exist today. However, although recent air samples at all the potentially hazardous operations had not been taken at this time, it is likely that where local ventilation is provided the present control is as good as, if not better than, that previously recorded. This applies as well to other areas besides the commercial building. In addition, observations and the limited air tests made indicate that many operations do not release uranium dust to the air because they are performed after the metal has been clad.

There are certain uncontrolled operations, however, such as weighing in the accountability area (2 yr. old records indicate extremely high dust concentrations while weighing U-235 pellets), hot rolling of unclad material in building #9 and the shearing and punching of unclad material which tend to give rise to airborne contamination. Although corroborative air tests could not be made, it would appear that on the basis of observations, reports in the literature, and knowledge of the operations excessive dust concentrations could be obtained. Despite the company's claim that these operations have been checked carefully to insure no loss of material and excessive airborne contamination, and although hot rolling is done with a lubricant to coat the uranium and prevent excessive oxidation, it is felt that, without ventilation, incidents may occur resulting in massive exposures to the workers.

The degreaser, sodium silicate bonding spray booth, and laboratory hoods in building #9 are not operating in accordance with good engineering practice or New York State Code Rule requirements.

The performance of welding, particularly heliarc welding in building #9 with its potential generation of excessive quantities of ozone may also tend to injure the workers' health.

General

The filter box dust collectors provided for many of the operations are not deemed too desirable. The workers may be exposed to excessive dust concentrations while changing filters, despite the spraying which is done, and excessive building of dust on the filters can cause reduced air flow at the hoods with subsequent worker exposure.

External Radiation

The external radiation hazard appears to be quite slight. For all practical purposes, this hazard is due primarily to beta particles. The alpha emissions will not penetrate the outer layer of skin and the amount of gamma radiation is negligible. The beta radiation is kept under control by the practice of having the employees handling the uranium wear leather palm gloves. Therefore, the film badge readings, which this year showed only one weekly exposure slightly in excess of 300 mr. may not be completely indicative of the actual personnel exposure because of the protection offered by the gloves and other clothing. A weekly permissible dose rate of 600 mrem may also be considered to be applicable in this instance since Code 38 permits this rate in the skin for employees whose entire body or major portion thereof is exposed to radiation from external sources.

CONCLUSIONS

The plants appear to be operating in substantial compliance with Code Bulletin No. 38 and in general to be providing proper facilities and trained personnel for the detection and control of contaminants and external radiation present in quantities which would tend to injure the workers' health. However, as a safety factor, to prevent any potential massive internal exposure to radioactive materials as well as to forestall any unsafe future condition caused by the operation of the more standard equipment, it is felt that additional control or modification of existing conditions as indicated below is necessary.

RECOMMENDATIONS

1. Local exhaust ventilation should be provided for

   a) weighing operations in the accountability section,
   b) hot rolling of unclad material in building #9, and
   c) shearing and punching operations on unclad materials.

2. The filter box dust collectors should be replaced by continuous cleaning cloth arrestors or other suitable types which can be cleaned externally and which have constant pressure drops so that uniform air flow at the hoods will be maintained. This type of collector should also be used in all future installations.

3. Local exhaust ventilation should be provided for production welding in building #9. Local hoods as indicated on engineering plate #166 exhausted to maintain at least 100 fpm at the arc can probably be used.

4. The degreaser ventilation rate should be increased to maintain at least 60 cfm per square foot of tank area.

   a) A thermostat should be provided in the liquid zone connected to control or shut off the source of heat when the contents reach a temperature not higher than 20°F in excess of the boiling point of the uncontaminated solvent.

   b) If not already regulated, the hoist speed should be set not to exceed 11 feet per minute.

5. The space between the floor and table top in the sodium silicate bonding hood should be covered and baffles provided in the hood.

6. The ventilation rate in the laboratory hoods should be increased to maintain at least 100 fpm through the open areas. If not already provided, adequate filters should be installed for cleaning the air before it is discharged to the out of doors.

7. Letter of recommendations to company.

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